The Frequency of Inquiry-Based Instruction and Its Effect on Students' Achievement on High Stakes Tests

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Introduction

Standardized testing has been around since the 1850s (Longo, 2010). At first, these tests were developed to help teachers, school administrators, and public officials find out more about the learning process and to determine how our nation's schools were doing. Later, information from high-stakes tests was used to help keep schools accountable in order to receive funding. Now, testing is driving instruction (Longo, 2010). These tests will have a greater effect on accountability, as students may need to pass standardized tests in order to pass their science courses. Science teachers must prepare their students to be successful in these critical-thinking tests, which involve more open-ended and problem-solving questions. Teachers need to consider inquiry-based instruction and how these instructional practices can improve students' ability to think critically.

Inquiry-based instruction in science education focuses on student-constructed learning as opposed to teacher-transmitted information (Longo, 2010). Because students are building their own understanding of science and their critical-thinking skills concurrently, they need a great deal of practice to develop these latter abilities. Critical-thinking practice should, theoretically, help students to become proficient in analyzing science problems (Cohen and Hill, 2001). High-stakes tests measure the critical-thinking ability of students and the students' ability to construct meaningful answers to problems (Cohen and Hill, 2001). The more teachers challenge their students to solve problems in the classroom, the better students will develop the ability to answer open-ended questions in a standardized assessment (Resnick and Resnick, 1992). Finally, in an inquiry-based curriculum, the students are engaged in their learning, and students who are engaged in their learning will have the opportunity to develop their critical-thinking skills (Wideen, 1997).

Literature review

Science is more than just the content knowledge that has been learned through time; it is an exciting, problem-solving, and engaging process of obtaining knowledge through inquiry. Inquiry-based instruction begins with a curriculum that is standards-based, including the ability to engage in the practice of science. Second, the curriculum includes assessments with open-ended questions that will reflect student proficiency not only in content knowledge but also show proficiency in the ability to use critical thinking skills to solve every day problems. Finally, the curriculum includes lessons that give students frequent opportunities to practice those critical thinking skills.

Standards: Desired Goals for the Teacher

The whole science concept of content knowledge and an understanding of the scientific process are evident in the National Standards of Science Education. In chapter 6 of the NSES, the standards state that students should have an "understanding of 'how we know' what we know in

science" (National Research Council, 1996, 105). These standards state that the "students should learn how to combine both the content knowledge that they learn and the process of science to have a complete understanding of science" (National Research Council, 1996, 105). The standards emphasize that all "students should have the opportunity to partake in the process of inquiry, which is the ability to observe different phenomena, to make inferences about the phenomena, and to test those inferences by experimentation" (National Research Council, 1996, 105). Further, the standards state "students should have the ability to think and act in ways of inquiry" (p.105). The skills that "students need to develop include: asking questions, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations and communicate scientific arguments" (National Research Council, 1996, 105).

As science educators, we are legally responsible to teach to these national standards and to individual state standards that are based on the national science standards. These standards drive what we teach in the classroom, both in the content and in the skills to conduct further investigations as the students learn about their world. Additionally, the No Child Left Behind Law of 2002 has placed more accountability on schools to close the achievement gaps within schools, especially those with minority or disadvantaged students (NCLB, 2002).

To make sure that national and state standards were being implemented on a local level, teacher support was imperative to ensure that local curricula supported these standards (Cohen and Hill, 2001). Researchers surveyed teachers about the new state standards. In the survey, the teachers stated that the standards matched their goals to help students learn critical-thinking science skills (Cohen and Hill, 2001). The teachers were given opportunities to implement new curricula that matched the state's goals as well as their own. When teachers implemented these new curricula, the test scores improved (Cohen and Hill, 2001). Resnick and Resnick (1992) stated that teachers must teach to a desired standard to help students achieve proficiency in the standard. Everything the teacher does in the classroom must give students the opportunity to develop those important critical-thinking skills. Teachers must allow the students many opportunities to answer science questions so that students can construct meaningful answers by making logical connections to the available evidence (Chinn and Malhotra, 2002). In addition, students need frequent opportunities to construct and plan investigations, to use appropriate tools to develop data, and to present a scientific argument (Chinn and Malhotra, 2002). An inquiry-based curriculum will give teachers the opportunity to achieve these goals in the classroom on a daily basis (Longo, 2010)

Many state standardized science tests are designed to show evidence of how well students have achieved the states' goals or science standards (Hammerman, 2005), including those critical-thinking standards. The states designed these tests intentionally to reform educational practices in schools (Popham, 1985). This measurement-driven instruction was meant to influence teachers to reform their curriculum to include scientifically proven methods of instruction in the classroom (Resnick and Resnick, 1992). Resnick and Resnick (1992) emphasized that the tests are an economical way for the states to make sure local schools are aligning their local curriculum to the standards, so the curricula could include teaching methods to develop critical-thinking skills.

Assessments: The Ability to Answer Open-Ended Questions

One way measurement-driven instruction has changed educational practices is to change the test format of standardized tests. The test format of these assessments has evolved from simple multiple-choice questions to more authentic and open-ended questions to show more of the

students' thinking ability (Cohen and Hill, 2001). For example, in 1994, California state assessments became connected to the newly formed state standards, not to the textbook standards (Cohen and Hill, 2001). To understand what the students were thinking, the assessments have been improved to match the level of the reformed state standards. More open-ended questions were used to test students' critical thinking, not just basic concept skills.

Since standardized testing includes more open-ended questions, teachers need to provide practice with more critical-thinking questions to enhance student learning and at the same time help students to do well in the standardized testing. Hammerman (2005) stated "Classroom assessments can be used to monitor, diagnose and enhance student learning" (p.29). One type of assessment is formative. These assessments can assist teachers in gathering information about their students' learning on a certain topic. These assessments can take many forms from just a simple question asked by the teacher to the students or the teacher giving the students a set of questions to answer. Teachers can use this information to change the instructional method to meet the needs of the students. In addition, students are given teacher feedback on these formative assessments to help them construct their explanations with correctness and clarity. Students did better on standardized assessments when taught by teachers who frequently used hands-on learning, critical-thinking activities, and teacher developed formative assessments in their curriculum (Hammerman, 2005). Students who designed their own experiments during inquiry-based instruction not only mastered all the content but received the highest scores in their formative assessments (Longo, 2010).

Resnick and Resnick (1992) also recommended that inquiry-based curriculum with assessments that include open-ended questions should be incorporated into all subjects across the board in the K-12 curricula to give students opportunities to develop the ability to answer open-ended questions with proficiency. In a 1997 study, middle school science teachers incorporated this inquiry-based curriculum into their classroom instruction (Enger, 1997). In this study, Enger investigated to see if the intervention of classroom instruction, using open-ended questions with middle school students, had any effect on those students' ability to answer open- ended science questions on a standardized test, subsequently given to the same students in their ninth grade year. During their middle school science instruction (6^{th} -8^{th} grades), these students had instruction in setting up data tables, graphing numbers, writing down their own observations from an experiment, and making predictions about what will happen in their experiments. When these students were surveyed about their instruction in middle school science classes, most of them stated that they had a great deal of instruction in dealing with open-ended questions. As for the results on the standardized test given to ninth grade students, the students had trouble with the clarity of their explanations and drawing inferences from the given information. The students had trouble transferring the ability to infer what they learned to other problems. This intervention of teaching the ability to answer open-ended questions had little effect on the students' ability to answer the open-ended questions on a standardized test. These open-ended questions gave the teachers a great deal of insight into the misconceptions that students may have in developing their explanations to these questions (Enger, 1997).

Abbott and Warfield (1999) studied another instructional intervention to help students in their ability to complete open-ended questions in standardized tests. They wanted to find out if teaching directly about how to solve problems would help students with these open-ended questions. High school teachers instructed their students in the ability to problem solve. The problem-solving course consisted of three areas: cooperative learning, multiple intelligences and a problem-solving method. During a 15-week period, students had direct instruction in cooperative learning in which students worked together to achieve higher results. What made these groups different from regular student group work was that students were assigned roles to help the group

succeed. They also received instruction on multiple intelligences to help students see that there were other ways to solve problems, allowing students to observe other students' strengths that might differ from their own. Finally, students were taught a problem-solving method that consisted of three parts: first, to investigate new information; next, to use the new knowledge to make decisions; and finally, to work with others to solve problems. Before students participated in the 15-week course, they had to answer a questionnaire based on their ability and confidence to solve problems and complete a standardized test with open-ended questions. After the 15-week course, the students were given the same survey and the same standardized test. The students showed more confidence in their ability to solve problems and their test scores increased slightly. The authors concluded that students must learn and practice problem-solving skills in schools. Schools should have curricula in place to help promote the practice of such thinking skills (Abbott and Warfield, 1999). For students to develop this process of thinking or the ability to explain concepts, they must be practiced over and over again and be used in many different situations as they go through their K-12 education (Resnick and Resnick, 1992).

To give students adequate practice in open-ended questions, teachers must have an adequate supply of these questions for their assessments. Popham (1985) stated that these open-ended assessment questions are very difficult to construct because the questions need to be clearly stated and fit the appropriate standards. Vendlinski, Nagashima, and Herman (2007) wanted to see if teachers could improve their development of these open-ended questions by collaborating with peers. The authors carried out their study to find out if teachers could collaborate in developing good questions for a science benchmark test. The study used three groups of teachers and other educational professionals. Each of the groups worked on a separate science unit. The questions went through detailed processes of being analyzed and tested. After the detailed pilot testing, the results of the study showed that teachers had no problem developing multiple choice or open-ended questions for the benchmark tests with collaborative assistance by other teachers and professionals. It was important to note that the questions were developed based on the instructional goals of each of the units and the teacher-developed questions had a clear prompt that was used to assess the students' knowledge as well as their higher-order thinking.

In addition to test format, other factors in standardized test preparation would be teacher beliefs about standardized testing and state instructional support for teachers. A study, conducted by Firestone, Monfils and Schorr (2004), found that standardized testing affected the way teachers prepared students for the tests. In this study, a three-year survey was conducted along with classroom observations and interviews with teachers in the state. The study found that teachers were preparing their students for the standardized testing in two different ways. As a state-test advocate, the teacher took a more didactic approach to instruction, making sure students had an opportunity to learn the material. On the other hand, if the teacher was against state tests, the teacher incorporated more of an inquiry approach with open-ended questions to guide instruction. Additionally, all the teachers in the Firestone, Monfils and Schorr (2004) study mentioned "the importance of support in terms of materials, curricular assistance and learning opportunities" (p.80). The teachers mentioned how difficult it would be to buy a new program to help student learning; however, it was easy to obtain materials associated with the state-testing program. The state provided materials to help teachers actively engage students with hands-on learning. Other state-offered assistance programs mentioned by the teachers were curricular reform and opportunities for teachers to learn about new instructional approaches implied by the state standards. Teachers who received support from school administrators and the state were more apt to use inquiry-based instruction than didactic instruction (Firestone, Monfils and Schorr, 2004). Resnick and Resnick (1992) indicated states should support this Measurement-Driven Instruction by providing teachers instructional materials, additional help, and state guidelines for student success in the standardized tests. Most importantly, teachers collaborated to implement these new instructional practices. In conclusion, the study showed that testing caused

teachers to explore more cognitively challenging, inquiry-based, instructional tasks (Firestone, Monfils and Schorr, 2004).

Early attempts to implement inquiry-based instructional practice failed because teachers did not have a clear understanding of the link between standardized assessments and the standards. Each of the test items was constructed so that each has a direct link to more than one of the standards (Hammerman, 2005). For example, Widen and O'Shea (1997) found that teachers in two British Columbia school districts tended to teach more through direct instruction than inquiry-based instruction as the students approached 12th grade to take their exit exam. The researchers studied 8th, 10th and 12th grade teachers over a two-year period. They interviewed and observed the lessons the teachers taught in their classrooms. The results showed that 8th and 10th grade teachers were willing to use more inquiry-based instruction, while the 12th grade teachers used more direct instruction. Some teachers even admitted that they did not let students explore as much in 12th grade because they wanted the students to do well in their exit exams. Teachers also admitted to narrowing their scope of what was taught in the course to cover just the content standards that would be on the test (Widen, 1997).

Instruction: Developing and Practicing Critical Thinking Skills

The missing piece of the puzzle is the rich and creative components of effective and frequent instruction to make sure that students are learning the science process in the classroom (Longo, 2010). The students need to have inquiry-based lessons that include practice in observations, opportunities in research, practice in developing thoughtful conclusions and understandings (Hammerman, 2005). Students must take responsibility for the problems they solve. In the constructivist approach, the teacher is the guide to student learning (Longo, 2010). As teachers learn more about and believe in these critical-thinking instructional practices, students will have many more opportunities to increase their science learning because they will be synthesizing their own information through the process of observation, reflecting on data, and providing logical conclusions based on the evidence (Hammerman, 2005).

Effective science instruction is based on an authentic approach to science teaching, a constructivist view on how students learn science, and many opportunities for active learning (Wideen et al., 1997). First, authentic science inquiry approach is giving students an opportunity to carry out research that scientists would perform (Chinn and Malhotra, 2000). Most students conduct simple textbook experiments that measure how a dependent variable changes as an independent variable changes. These simple practices can give a false impression of the process of science. In an authentic learning experience, students are given the opportunity to select their problem just like a scientist and to complete the scientific process. Most textbook activities do not include these types of authentic activities (Chinn and Malhotra, 2000). Research-based activities that are constructed by educational researchers include more hands-on activities and tasks that evaluate data presented in research reports (Chinn and Malhotra, 2000).

The last two components of effective science teaching are active learning and the constructivist viewpoint of how students learn science. According to Huber and Moore (2001), these two aspects are connected for a good inquiry-based lesson because not all hands-on learning would also be a good inquiry-based lesson. In an inquiry-based lesson, students must be actively engaged in their learning in order to build their knowledge of how scientists actually learn about the happenings of their world.

Purpose of this Investigation

According to the research in this literature review, all indicators pointed to a positive connection between the science standards and inquiry-based instruction. However, there was a need to further the empirical research on the effect that inquiry-based instruction has on the students' ability to succeed on standardized testing, because there has not been sufficient research to show how inquiry-based instructional methods may be connected to student performance on state standardized tests (Longo, 2010). As measurement-driven instruction drives local school districts to make decisions about their instructional practices, teachers needed more evidence to show that frequent use of inquiry-based instruction can help students do well on standardized testing. This investigation provided one more piece of evidence to substantiate that inquiry-based instruction has positive impacts on students' standardized test scores, which, in turn, should show student mastery of the science standards.

In this investigation, the instructional methods of science teachers in two groups of Pennsylvania high schools were compared. One of the groups of high schools was selected for significantly higher scores on the 11th grade science Pennsylvania System of School Assessments (hereafter referred to as PSSA). The second group of high schools had significantly lower scores in the same tests. A teacher survey was prepared and sent to science teachers in both schools, asking them how frequently they use inquiry-based instruction in their classroom. From the analysis of the surveys, I attempted to determine whether or not science teachers in a group of high schools with significant success in 11th grade science Pennsylvania System of School Assessments more frequently used inquiry-based instruction as compared to those in the lower-performing schools.

Method

Participants and Design

I began by selecting test schools to complete the survey. The PSSA website (Pennsylvania Department of Education, 2011) provided the data for the selection process. The website contained 11th grade PSSA science scores from all the Pennsylvania high schools. For this study, the data from years 2008, 2009, and 2010 were used. Two lists of the schools were compiled, one for high schools that achieved high scores for all three years and another list for high schools that achieved low scores for all three years. Scores were determined by the percent of students who achieved an advanced or a proficient score in the science PSSA. "High scores" were defined as when 60% or higher of the students taking the test received an advanced or proficient score, while "low scores" were defined when 30% or lower of the students taking the test received an advanced or proficient score.

After the two preliminary lists were compiled, additional data were compiled from the same PSSA website concerning students who were economically disadvantaged for both lists of schools. Based on this information, three pairs of schools were selected. Each pair included a school with high success in the 11th grade science PSSA and a school with low success but both schools in each pair had similar percentages of students who were economically disadvantaged. Next, the *School Matters* website (Council of Chief State Officers, 2011) was used to control other variables such as ethnic diversity, student-teacher ratios, and the location of the school. Each pair of schools was controlled for these other variables so that each school had a similar ethnic diversity in their student body, had similar student-teacher ratios, and had similar locations, such as rural, suburban or urban.

After the three pairs of test schools were selected, a survey was sent to science teachers in each school. Teachers were instructed not to place any names or other identifying information on the survey. After completing the survey, they were to return the surveys to the researcher in self-addressed stamped envelopes to ensure anonymity. To make sure that data could be analyzed and categorized correctly, each school received surveys that were printed on different colored paper in order to group them by participating school.

Results

Several independent measures t-tests were conducted to assess whether high-achieving schools and low achieving schools differed in terms of how frequently (where 1 = *never* and 5 = *more than five times/month*) teachers a) used open-ended questions for assessments, b) provided appropriate tools , c) engaged students in data-taking, d) had students create data tables, e) had students work in cooperative groups, f) had students work in groups, g) allowed students to use data to support explanations, h) provided guided questions to develop conclusions, i) constructed personal explanations of data, j) orally explained evidence, k) allowed students to research information to develop an hypothesis, l) allowed students to make observations, m) allowed students to create questions, n) allowed students to plan investigations, and o) allowed students to design experiments. The critical data for each test can be seen in Table 1.

Table 1. Descriptive and Inferential Statistics for Participants' Self-Reported Use of Various Inquiry-Based Learning Activities, as a Function of a School's Achievement in PSSA Scores

Classroom Activity	School Grouping	*M*	*SD*	*t*	*p*	η^2
Open-ended Questions	High-achieving	4.22	1.17	2.38	.023	.142
	Low-achieving	3.22	1.35			
Appropriate Tools	High-achieving	3.72	1.13	.66	.513	.013
	Low-achieving	3.44	1.38			
Data-Taking	High-achieving	3.61	1.04	1.32	.196	.049
	Low-achieving	3.11	1.23			
Create Data Tables	High-achieving	2.72	1.17	2.66	.012	.173
	Low-achieving	1.83	.786			
Cooperative Groups	High-achieving	3.83	1.50	.233	.825	.001
	Low-achieving	3.72	1.49			
Groups	High-achieving	4.17	1.34	.504	.617	.007
	Low-achieving	3.94	1.30			
Data to Support Explanations	High-achieving	3.94	1.11	.743	.463	.016
	Low-achieving	3.67	1.13			
Guided Questions	High-achieving	3.94	1.00	2.00	.054	.105
	Low-achieving	3.22	1.16			

Classroom Activity	School Grouping	*M*	*SD*	*t*	*p*	η^2
Explanations of Data	High-achieving Low-achieving	3.61 3.06	1.24 1.16	1.38	.175	.053
Oral Explanations	High-achieving Low-achieving	2.94 2.83	1.21 1.38	.256	.799	.002
Hypothesis Development	High-achieving Low-achieving	2.33 2.28	1.03 .958	.168	.868	001
Student Observations	High-achieving Low-achieving	4.56 3.56	.784 1.38	2.67	.012	.173
Student-created Questions	High-achieving Low-achieving	2.83 2.72	1.15 1.32	.269	.789	.002
Student-researched Investigations	High-achieving Low-achieving	1.83 1.83	.985 .707	<.001	1.00	<.001
Student-designed Experiments	High-achieving Low-achieving	2.11 2.00	1.18 1.02	.301	.765	.003

In terms of significant effects, teachers in high-achieving schools used open-ended questions more frequently than teachers in low-achieving schools, allowed students to create data tables more frequently, and allowed students to make more observations more frequently than teachers in low-achieving schools. Furthermore, one inquiry-based instructional technique approached significance; teachers in high-achieving schools used guided questions more frequently than those teachers in low-achieving schools. However, a review of the effect size statistics for all of these results shows that the achievement level of a school has fairly little to do with the instructional methods utilized by faculty, as all η^2 values < .20.

In terms of non-significant effects, there was no difference between the two groups of teachers in how frequently they used the following instructional techniques: provide students with appropriate tools to develop their conclusions, engage students in taking data, use cooperative groups in the classroom, have students work in groups, allow students to use data to support explanations, allow students to construct their own personal explanations of the data, allow students to orally defend their explanations, allow students to develop hypothesis, allow students to develop questions based on observations, allow students to plan investigations, and allow students to plan an experiment.

Furthermore, another independent measures t-test was conducted to assess whether teachers in high-achieving schools and low-achieving schools differ in their use of a published science inquiry-based program (where 1 = *yes* and 2 = *no*). The analysis revealed no significant difference between the teachers in the high-achieving schools (M= 1.61, SD = .50) and the teachers in low-achieving schools (M= 1.78, SD = .43), t (34) = -1.07, p = .291, η^2 = .03 (two-tailed).

Discussion

The hypothesis of this study was to see if science teachers in a group of high schools with significant success in the 11th grade PSSA scores more frequently used inquiry-based instruction as compared to science teachers in a group of high schools with significantly lower PSSA scores. This prediction was supported by only three of the 16 inquiry-based instructional techniques surveyed. Students who generally were more successful with PSSA testing had teachers who gave their students frequent opportunities to make observations in their classrooms, allowed their students to create their own methods of data collection more frequently, and more frequently assessed their students using open-ended questions. These other inquiry-based instructional techniques did not have an impact on student achievement in PSSA testing: 1) having adequate tools for students to conduct investigations, 2) having students collect data, 3) using cooperative groups in the classroom, 4) having students do work in groups, 5) having students to think critically about their data, 6) having students use guided questions in developing questions, 7) having students construct personal explanations of their data,8) having students to orally explain their conclusions, 9) having students do research to develop a hypothesis, 10) having students create questions based on their observations,11) having students to plan investigations, 12) having students design experiments, and 13) having teachers use a published inquiry-based program in the classroom. Even though there was significance with the three instructional methods, the analysis showed that other unidentified factors also played a role in distinguishing high- and low-performing schools, as effect size statistics for the significant findings were relatively small.

The results suggest that teachers from both groups were using over 50% of the inquiry-based instructional techniques at least three times a month. These teachers may have known more about inquiry-based instruction through professional development, pressure to succeed in standardized tests, and materials available in textbooks and the Internet (Firestone Monfils and Schorr, 2004; Hammerman, 2005). Teachers who have support from administrators and the right materials could be implementing these instructional techniques on a more frequent basis because they are based on national and state standards (Firestone, Monfils and Schorr, 2004). Teaching experience could also lead to more teachers using these instructional techniques because they feel more confident and are willing to take risks to try these inquiry-based tools (Firestone, Monfils and Schorr ,2004). Teaching experience could also affect how teachers deliver these inquiry-based instructional techniques. Teaching delivery will affect how motivated students will be about science, and therefore being motivated to succeed on the state tests (Longo, 2010, Hammerman, 2005). Other reasons that these results could have occurred could be due to students' ability to problem solve (Abbot, 1999), infer conclusions from data (Enger, 1997), and students' content knowledge on the scientific method (Turner and Rios, 2008).

Second, the results of this study supported the importance of classroom assessments with open-ended questions, because the frequent use of this inquiry-based instructional technique was connected more with higher-performing schools than with lower-performing schools. The frequent use of teacher-developed assessments is linked to success in state tests (Hammerman, 2005). More importantly, formative assessments were a crucial component of student success, because these assessments gave teachers the ability to monitor, diagnose and enhance student learning. Formative assessments will give teachers the ability to correct misconceptions and assist students in correcting them. Formative assessments will also give students more opportunities to ask more questions, to conduct investigations and design projects (Hammerman, 2005). When teachers challenged their students with more open-ended questions, then their students did better in any assessment (Resnick and Resnick, 1992).

Third, the results of this study showed how the frequent use of student-centered curriculum in the classroom, such as students making frequent use of observations and students creating their own data tables, will improve student success in state assessment more than those teachers who do not make use of such curriculum. Longo (2010) stated that teachers who allowed students to change lab procedures and data taking had students who had a better understanding of concepts and also did better on teacher assessments. Chinin (2000) stated that students who make observations and cultivate them into an authentic inquiry task are enabled to reason scientifically and develop the ability to analyze test prompts in standardized tests (Turner and Rios, 2008).

Conclusion

The data in this study suggest that teachers are beginning to accept the challenge to change their curriculum, so their instructional practices match the national and state standards. The state assessments are succeeding to drive local changes in some local curriculum to match the national and state science standards. Schools that scored higher in the standardized testing have teachers and administrators who created and implemented curriculum that matched the national and state science standards, included more student practice in open-ended questions, and gave students more practice in making observations and in creating their own data tables. When schools adapt science curriculum that include these criteria, they will have students who will be proficient in the standardized testing. But more importantly, they will have students who will be curious about science and be proficient in how science can help solve problems.

This research gives teachers one more small piece of evidence that inquiry-based instruction will prepare students to succeed in standardized testing. Since there is a temptation to teach to the test, an inquiry-based curriculum will provide teachers a creative way of letting each student use his/her creativity to put together observations and data. With the data at their fingertips, the teacher can ask open-ended questions so that students construct the science concepts being learned.

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